Lunar Librarian Newsletter
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LRO News

What's New with LRO

LRO's modular spacecraft design is really paying off right now. While the electrical team connects the Power System Electronics (PSE), the Command and Data Handling (C&DH) system, and the Propulsion and Deployment Electronics (PDE) to the flight harness, other teams are able to work on their portion of the spacecraft. For example, the propulsion team is putting the finishing touches on the propulsion module, the mechanical team is installing the reaction wheels on the -z panel, and the facilities team is baking out the Instrument Module. The PSE and C&DH each attach to all of the other electronics in the Orbiter, and we had to check out every signal on every connector, so the integration took a few days. We are currently working on the PDE electrical integration. We had our first official power-up of the spacecraft last week, successfully sending commands and receiving telemetry. The Gimbal Control Electronics (GCE) are mounted to the panel, but not yet connected. The GCE receive commands from the flight software and transmit them to the gimbals, which are the pieces of hardware that control the movement of the high gain antenna and the solar array on the spacecraft.

This photo shows the reaction wheels mounted on the -z panel. The black heat pipes come together between the wheels and carry heat out through the hole in the -z panel to the radiator panel. By changing the speed of the wheels, the attitude control system can rotate the Orbiter and precisely point the instruments. Note the extra printing on the cover of the wheel on the top left.

We hope this small memorial, which will end up on the surface of the moon after LRO's mission ends, provides some comfort to Joe's family.

Kevin Blahut and Rex Richardson (wearing headset) perform safe-to-mate checks of the flight harness during integration of the PDE.

Al Lacks (left) and Carroll "Trick" Trickey perform the incoming inspection of the CRaTER instrument.

Al Lacks (left), Gordon Casto (center back), and Giulio Rosanova prepare to move the instrument module to the vacuum chamber (behind Gordon). The flight heaters, thermostats, and temperature sensors are already installed on the panel. Aluminum tape covers the heaters and spreads the heat out. Vacuum bake-out of the instrument module last week removed volatile contaminates, ensuring that we don't fog over the instruments when we install them..

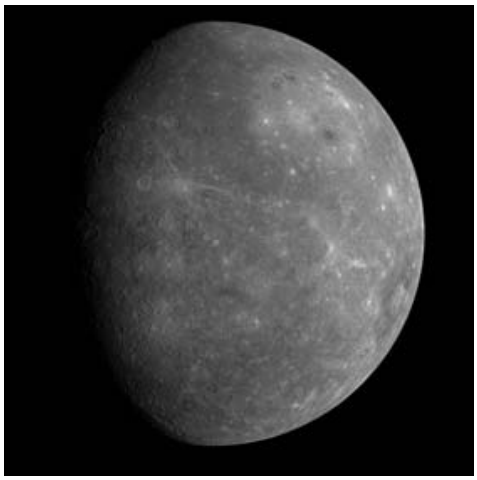
The New Year has started with a flurry of activity. The CRaTER instrument was delivered to Goddard Space Flight Center on January 6th. We uncrated the instrument and ran it through its post-ship functional testing. The spacecraft bus and the avionics panel are in the LRO clean room, and the mechanical team has started installation of electronics on the panel.

LRO team members prepare the Avionics Module flight wiring harness for bake-out. The harness was placed in a vacuum chamber and heated in order to drive off remaining volatiles before installation on the spacecraft. The bake-out ensures that the harness will not contaminate the instruments when the entire spacecraft operates in vacuum. The vacuum chamber is shown in the background. Pictured from left to right are: Trick, Larry Gibb, Doug Duvall, Phil Luers, Curtis Dunsmore

Charles Baker, the LRO thermal lead, inspects the flight radiator panel. This panel will be mounted to the overhead face of the spacecraft. Heat is conducted from the avionics to this panel, and this panel dumps the heat to space. The radiator panel is covered in Optical Surface Reflectors (OSR) that enables the panel to continue to run cold even in direct sunlight.

In the photo to the left, Bob Thompson wires heaters and thermostats on the +y side of the instrument module. The flight instrument module (IM) has most of its heaters and thermostats installed. This equipment will ensure that our instruments do not get too cold when they are off, and it will also keep them at a proper temperature when they are operating. When the thermal hardware installation is complete, we will put the IM in a vacuum chamber and bake out any remaining volatiles that could fog our optics. The large holes on the right will accommodate the LROC Narrow-Angle Cameras.

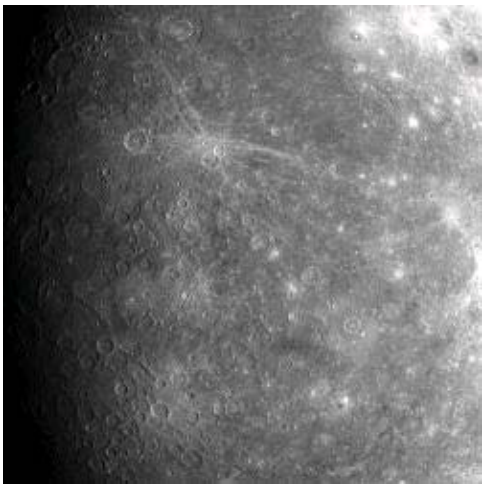
NASA News



MESSENGER's First Flyby of Mercury

It has been more than three decades since a spacecraft has visited Mercury. The last to visit was Mariner 10 with its three flybys March 29, 1974, September 21, 1974, and March 16, 1975. On January 14, 2008, NASA's MESSENGER spacecraft made its first of three flybys of Mercury.

MESSENGER passed 200km above the Mercury surface. During its first flyby, MESSENGER took these images, taken by the Wide Angle Camera (WAC) of the Mercury Dual Imaging System (MDIS). This portion of Mercury is half of the 55% previously unseen by Mariner 10. The next two flybys will image the rest of Mercury.



The image to the right: "On the upper right is the giant Caloris basin, including its western portions never before seen by spacecraft. Formed by the impact of a large asteroid or comet, Caloris is one of the largest, and perhaps one of the youngest, basins in the Solar System. The new image shows the complete basin interior and reveals that it is brighter than the surrounding regions and may therefore have a different composition. Darker smooth plains completely surround Caloris, and many unusual dark-rimmed craters are observed inside the basin. Several other multi-ringed basins are seen in this

image for the first time. Prominent fault scarps (large ridges) lace the newly viewed region."
(http://messenger.jhuapl.edu/gallery/sciencePhotos/image.php?page=3&gallery_id=2&image_id=129)

Image to the left: "Just above and to the left of center of this image is a small crater with a pronounced set of bright rays extending across Mercury's surface away from the crater. Bright rays are commonly made in a crater-forming explosion when an asteroid strikes the surface of an airless body like the Moon or Mercury. But rays fade with time as tiny meteoroids and particles from the solar wind strike the surface and darken the rays. The prominence of these rays implies that the small crater at the center of the ray pattern formed comparatively recently."
(http://messenger.jhuapl.edu/gallery/sciencePhotos/image.php?gallery_id=2&image_id=141)

NASA, APL, and Carnegie are releasing new images daily. Please visit http://messenger.jhuapl.edu/ for the latest news about what was discovered and images from MESSENGER.

Science News

NASA Science News has published several articles last month. Please follow the links to read the full stories. Check out our RSS feed at http://science.nasa.gov/rss.xml!

NASA Spacecraft Make New Discoveries About Northern Lights

NASA's fleet of THEMIS satellites has made some surprising new discoveries about outbursts of Northern Lights and the source of their power. Findings include giant magnetic ropes that connect Earth to the Sun and explosions in the outskirts of Earth's magnetic field.

http://science.nasa.gov/headlines/y2007/11dec_themis.htm?list907815

Is a New Solar Cycle About to Begin?

The solar physics community is abuzz this week. No, there haven't been any great eruptions or solar storms. The source of the excitement is a modest knot of magnetism that popped up on the sun, possibly heralding the start of a new solar cycle.
http://science.nasa.gov/headlines/y2007/14dec_excitement.htm?list907815

NASA Announces Discovery of Assault by a Black Hole

A powerful jet from a supermassive black hole is blasting a nearby galaxy and possibly causing profound problems for planets in the jet's path.
http://science.nasa.gov/headlines/y2007/18dec_assault.htm?list907815

Christmas Eve Sky Show

Consider it an early Christmas gift: On Dec. 24th the Moon and Mars are putting on a pleasing late-night sky show.
http://science.nasa.gov/headlines/y2007/20dec_christmaseve.htm?list907815

Asteroid Threatens Mars

NASA-funded astronomers are monitoring a Tunguska-sized asteroid that will pass

within 30,000 miles of Mars on Jan. 30, 2008. Based on data currently available, the space rock has a 1-in-75 chance of actually hitting Mars and blasting a crater more than half-a-mile wide.

http://science.nasa.gov/headlines/y2007/21dec_2007wd5.htm?list907815

SERVIR: NASA lends a helping hand in Central America

NASA is bringing high-tech satellite data and visualization tools to bear on the unique environmental problems of Central America.
http://science.nasa.gov/headlines/y2007/28dec_servir2.htm?list907815

Solar Cycle 24 Begins

Hang on to your cell phones, a new solar cycle is underway. Solar Cycle 24 began last week with the appearance of a magnetically "backward" high-latitude sunspot.

http://science.nasa.gov/headlines/y2008/10jan_solarcycle24.htm?list907815

Ulysses Flyby of the Sun's North Pole

At a pivotal moment of the solar cycle, the ESA/NASA Ulysses spacecraft is flying over the sun's mysterious North Pole.
http://science.nasa.gov/headlines/y2008/14jan_northpole.htm?list907815

Exploring the Cosmos in Braille

Images from NASA telescopes are jewels of the space program, marvelous to behold. But how do you behold them when you can't see? The answer lies between the covers of a new NASA-funded book written in Braille, Touch the Invisible Sky.
http://science.nasa.gov/headlines/y2008/15jan_touch.htm?list907815

Radical New Lab Fights Disease Using Satellites

A cutting-edge laboratory has opened in Alabama. Its mission: to combat maladies ranging from asthma to malaria to stroke using data from NASA satellites. Space scientists and public health officials are working together to train the doctors of tomorrow in this far-out approach to medicine.

http://science.nasa.gov/headlines/y2008/16jan_newlanguage.htm?list907815

Mercury Flyby Sets Stage for New Discoveries

Last week's historic flyby of Mercury by NASA's MESSENGER spacecraft gathered 500 megabytes of data and more than a thousand high-resolution photos covering nearly six million square miles of previously unseen terrain. "Discoveries are at hand," say members of the mission science team. Read today's story for a hint of things to come.
http://science.nasa.gov/headlines/y2008/21jan_mercuryflyby.htm?list90781

A Violent History of Time

NASA is preparing to launch a new space telescope named GLAST to study the most violent explosions in the history of our Universe.
http://science.nasa.gov/headlines/y2008/24jan_glast.htm?list907815

Librarian News

The LRO EPO team is off to Ames Research Center in CA, the end of this month. We will be doing a workshop for the Californian Librarians. If you have any program ideas that you would like to share with them, please drop me an email: heather_weir@ssaihq.com

Happy New Year!!

Mr. Logan nose that you have been making plans for this summer. Please let us know what you have been up to!

Links of the Month…

. Later this month an asteroid, Asteroid 2007 TU24, will fly 538,000 kilometers (334,000 miles) of Earth.

. http://www.nasa.gov/topics/solarsystem/features/asteroid-20080125.html

. This interesting teaching kit uses video simulations of shaking during the 1906 earthquake as a backdrop for learning about the science of earthquakes and the hazards that are produced during a real event. The site links to a Living in Earthquake Country Teaching Box that was prepared collaboratively in 2005 with other teaching and science organizations for educators.

. http://earthquake.usgs.gov/regional/nca/1906/simulations/classroom.php

. ALL KNOWN BODIES IN THE SOLAR SYSTEM LARGER THAN 200 MILES IN DIAMETER,) This diagram is useful in showing students why Pluto was "demoted".

. http://kokogiak.com/solarsystembodieslargerthan200miles.html

. NEAR EARTH OBJECTS PROGRAM, NASA, “Enter the designation or name of any asteroid or comet, and a 3D orbit visualization tool will appear for that object. Make sure you have Java enabled on your browser. You can also select from the list of Potentially Hazardous Asteroids provided below.” Thought at first it was just a static model, which was interesting enough, but using the buttons at the bottom left you can get it to play at different speeds, and see the asteroids and planets moving in their orbits. You can also zoom in and out with the slider at the bottom right to get the solar system perspective or just the inner planets. http://neo.jpl.nasa.gov/orbits/

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Monthly Activity

Staying Cool Module-
http://btc.montana.edu/messenger/teachers/Modules/Lessons/SensingEnergy.pdf

Sensing Energy

Lesson Summary

Students will explore the unseen energy produced by the sun.

Objectives

Students will be able to:

- light has components that are both visible and invisible to our eyes.
- exposure to light can be measured and controlled
- exposure to light can change the properties of an object

Concepts

- The Sun produces energy- both visible and invisible to our eyes.
- The light we see is visible energy from the Sun reflected off surfaces.
- Some of the Sun's energy is received on Earth as ultra-violet energy that can produce skin burns and cancer.
- There are ways of blocking UV radiation.

This activity will address the following questions:

- What types of energy does the Sun produce?
- How can we sense different types of solar radiation?

Science Overview:

We are a star-powered planet, and our star, the primary source of energy on Earth, is the Sun. Objects on Earth absorb some of that energy, and reflect or radiate away the rest. Light and heat are just two forms of energy or radiation emitted by the Sun. The word 'radiation' refers to the way energy is transmitted through space and through air.

Visible light is a form of energy to which our eyes are sensitive. Here on Earth, visible light is usually produced when material is heated so that it glows. For example, in a regular light bulb, electricity flowing through a filament in the bulb heats it up and causes it to glow. As a result, light and heat are produced.

The Sun, too, produces light, but this energy is caused by nuclear reactions deep within the Sun. The Sun is really just a mass of hot gasses that explode in a way similar to a nuclear bomb. However, in the Sun, the explosions have been going on for five billion years and are expected to continue for another five billion!

Visible light is only one kind of solar radiation (energy produced by the Sun). Other forms include gamma, X-rays, ultraviolet (UV), infrared and radio waves. We cannot see these forms of energy (though some animals can see a little infrared), but we have other ways of detecting their presence. For example, if we stay outdoors too long, we might get a sunburn, which is caused by the Sun's ultraviolet (UV) energy. We can also use instruments to measure the presence of such invisible forms of energy. This lesson will use UV Detection Beads which change color in the presence of UV radiation.

Only some of the Sun's energy reaches us on the Earth. Much of it is stopped by the Earth's atmosphere. For example, most UV energy is absorbed by ozone in the upper atmosphere, but some of it still gets through. The UV energy that passes through the Earth's atmosphere can not only harm us by burning our skin, but it can cause other problems such as skin cancer and damage to our eyes. The amount of Sun's energy (including the harmful ultraviolet) arriving at the Earth's surface depends on several

things:

- How many clouds are overhead and how thick and dark they are (though remember that you can get sunburned even if it is cloudy!)
- The altitude. How high up from sea level are you?
- The amount of humidity. How much water vapor is in the air?
- How much dust and dirt is in the air?

These factors determine not only the amount of visible light reaching the planet, but also how much invisible energy is present. The question of invisible forms of the Sun's energy is important especially for spacecraft, because they fly outside of the Earth's protective atmosphere, and are more subject to their very dangerous effects.

Materials

- Five or six Ultra-violet Detection Beads* • water per child • paper clips
- lamps, overhead projector, a grow-light for • plastic wrap plants • a paintbrush or sponge
- 9 empty, opaque film canisters per group • Sunglasses
- Colored filters • Sunblock lotion sunscreen (spf 5 or 8, and
- a white piece of cloth 30)
- a black piece of cloth • Flashlight
- a baseball cap • UV eyeglasses
-

Procedures Part 1

- Provide each student with a few of the Ultra-violet light Detection Beads. Explain that they have a detection tool in their hand that will turn color when a special kind of energy is present.
- Have the students move around the room, looking at the color of their beads, placed under different sources of light (e.g. lamps, overhead projector, a grow-light for plants). Note that fluorescent lighting will not change the beads' color. As the students move towards the window they should notice that their beads will begin to change color. Take them outside if possible; it need not be a bright sunny day.
- Class discussion: Prompt students with the following questions to help them develop an explanation for the changes they are seeing in the UV beads.
- What do you notice about the beads? (They should say a change in color)
- What color were they before? What color are they now?
- Are all the beads changing color? If not why not? If so, why do you think?
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Part 2

. Choose a time when the sun is high in the sky. Work in an area that is in full sunlight but that has a shaded area nearby. This may be outside or indoors by a sunny window.

. Arrange the students into groups of 3-4 and distribute materials.

. Have each group of students put three UV beads in each film canister (you will not be using the lids unless you want to prevent the beads from escaping during the walk to the outdoors). Remove lids once outside. Different coverings will be tested in this experiment.

. Instruct each group to test the following nine scenarios (if it is difficult to do all 9 tests at the one time, break the experiment into a couple of separate sessions):

. Canister 1. (control) Set it on a desk or the ground with nothing over it.

. Canister 2. Lay a white piece of cloth over it.

. Canister 3. Lay a black piece of cloth over it.

. Canister 4. Put sunglasses over this canister.

. Canister 5. Put a baseball cap over this canister.

. Canister 6. Fill this canister with water.. String the beads on a paper clip so that they will sink.

. Canister 7. Cover this canister with plastic wrap.

. Canister 8. Cover this canister with plastic wrap and then apply a coat of sunscreen (spf 5 or 8) to the plastic with a paintbrush or sponge.

. Canister 9. Repeat the instructions for the previous canister using a spf 30 sunscreen.

. Tell students to let their canister sit for five minutes in the sunlight- either outdoors or in a sunny window.

. While waiting for the results to appear, conduct a whole group discussion to have the students predict what might happen to the beads in each of the canisters. Prompt with questions if necessary, such as:

. What do you think will happen to your beads? Why?

. Will the same thing happen to everyone else's beads?

. What colors do you predict they will become? What makes you say that?

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. After five minutes, have students check the canisters one at a time and record the results on Worksheet 1 (at end of this section). Before checking they will need to move the canister to the shade and look quickly. The response time of the beads is very rapid. If the beads are not examined in the shade immediately and if the students look too slowly, the results will not be valid.

. Each group should enter their results on a student worksheet

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Discussion & Reflection

The point of this exploration is to think further about the Sun's energy. Have each group discuss their observations amongst themselves for two or three minutes, and perhaps choose a spokesperson for the entire class discussion, if necessary. Bring the groups together, and discuss the basic findings, and what caused them. Prompt with questions

such as:

- In which of the canisters did the beads change color?
- Did they all change to the same colors?
- Why do you suppose that certain beads changed color and not others?
- Look at the results from the different canisters, and compare two, now three canisters. What do you notice? How do the color changes in each of the canisters compare? For example, is white cloth different from black cloth in changing the amount of UV radiation that reaches the beads? Which materials best blocked ultra-violet radiation?

Record observations of UV beads in film canisters.

CANISTER	START COLOR	END COLOR
Canister 1. (control) on the ground with nothing over it	_____	_____
Canister 2. covered with a white piece of cloth	_____	_____
Canister 3. covered with a black piece of cloth	_____	_____
Canister 4. covered with sunglasses	_____	_____
Canister 5. covered with a baseball cap	_____	_____
Canister 6. filled with water	_____	_____
Canister 7. covered with plastic wrap	_____	_____
Canister 8. covered with plastic wrap and a coat of sunscreen (spf 5 or 8)	_____	_____
Canister 9. covered with plastic wrap and a coat of sunscreen (spf 30)	_____	_____